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NASA's In-Space Manufacturing Project: A Roadmap for a Multimaterial Fabrication Laboratory in Space

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Human space exploration to date has been limited to low Earth orbit and the moon. The International Space Station (ISS) provides a unique opportunity for NASA to partner with private industry for development and demonstration of the technologies needed to support exploration initiatives. One challenge that is critical to sustainable and safer exploration is the ability to manufacture and recycle materials in space. This paper provides an overview of NASA's in-space manufacturing (ISM) project, its past and current activities (2014-2017), and how technologies under development will ultimately culminate in a multimaterial fabrication laboratory ("ISM FabLab") to be deployed on the International Space Station in the early 2020s. ISM is a critical capability for the long endurance missions NASA seeks to undertake in the coming decades. An unanticipated failure that can be adapted for in low earth orbit, through a resupply launch or a return to earth, may instead result in a loss of mission while in transit to Mars. To have a suite of functional ISM capabilities that are compatible with NASA's exploration timeline, ISM must be equipped with the resources necessary to develop these technologies and deploy them for testing prior to the scheduled de-orbit of ISS in 2024.

The presentation provides a broad overview of ISM projects activities culminating with the Fabrication Laboratory for ISS. In 2017, the in-space manufacturing project issued a broad agency announcement for this capability. Requirements of the Fabrication Laboratory as stated in the solicitation will be discussed. The FabLab will move NASA and private industry significantly closer to changing historical paradigms for human spaceflight where all materials used in space are launched from earth. While the current ISM FabLab will be tested on ISS, future systems are eventually intended for use in a deep space habitat or transit vehicle. The work of commercial companies funded under NASA's Small Business Innovative Research Program (SBIR) is also discussed, as these activities, from development of recyclable packaging for ISS to additive manufacturing capabilities for metals and electronics, could also potentially be infused into future exploration capabilities. Key data from ISM projects to date will also be summarized.